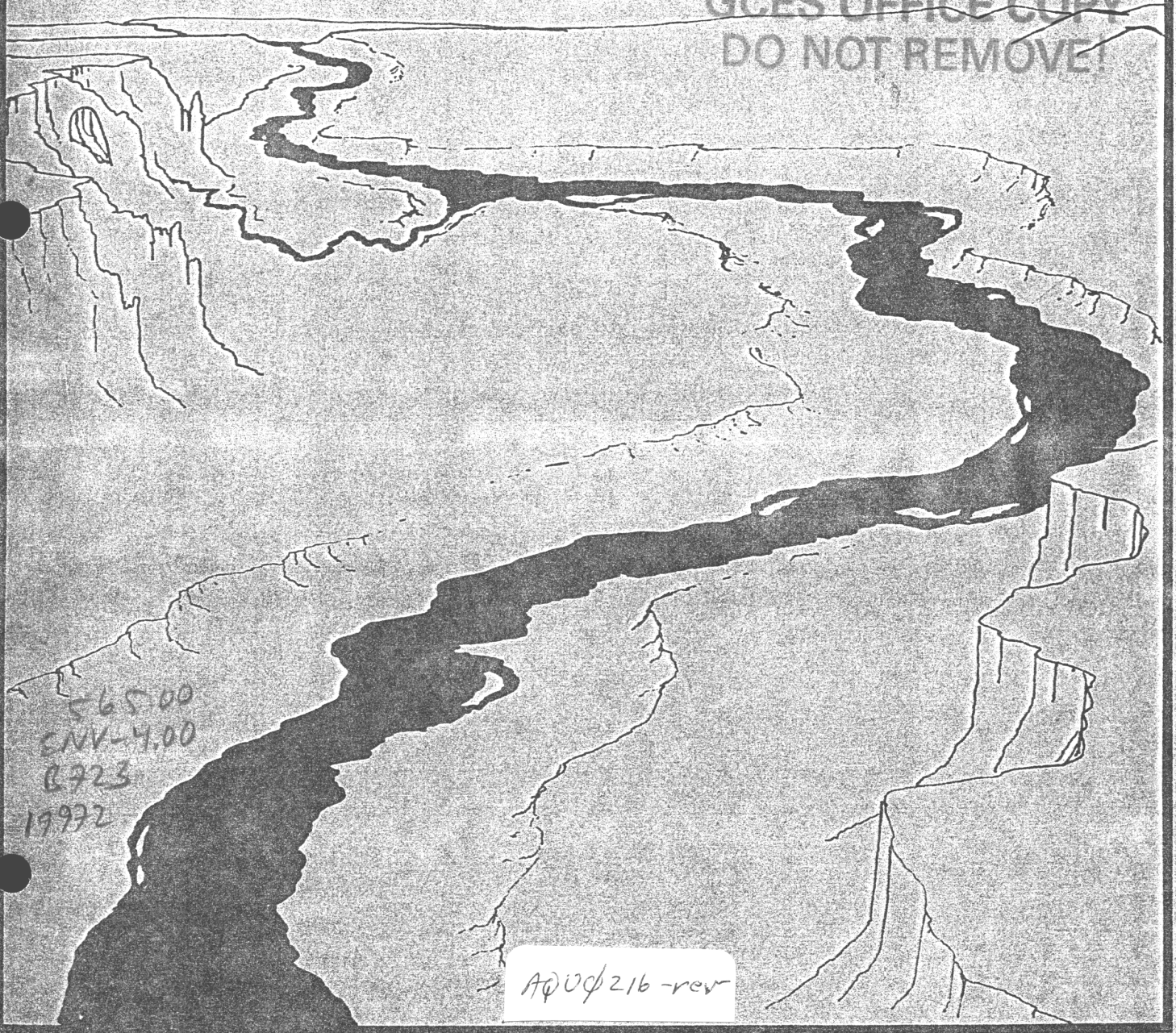
Bonytail Chub Recovery Plan



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BONYTAIL CHUB

Revised
RECOVERY PLAN

(Original Approval: May 16, 1984)

Prepared by the Colorado River Fishes Recovery Team

For
Region 6
U.S. Fish and Wildlife Service
Denver, Colorado

Approved: Galen L. Buterbaugh GALEN L. BUTERBAUGH
Regional Director, U.S. Fish and Wildlife Service

Date: 9-4-90

DISCLAIMER PAGE

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect the species. Plans are prepared by the U.S. Fish and Wildlife Service, sometimes with the assistance of recovery teams, contractors, State agencies, and others. Objectives will only be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints. Recovery plans do not necessarily represent the views nor the official positions or approvals of any individuals or agencies, other than the U.S. Fish and Wildlife Service, involved in the plan formulation. They represent the official position of the U.S. Fish and Wildlife Service only after they have been signed by the Regional Director or Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks. Because the current distribution is poorly known and the population numbers are so low, cost estimates for many recovery actions may be imprecise or unknown.

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Numerous other persons provided reviews and/or information for the preparation of this plan. The Service greatly appreciates the invaluable assistance provided by team members (past and present), consultants, and other individuals who contributed to the preparation of this document.

EXECUTIVE SUMMARY

The bonytail chub (Gila elegans) was listed as an endangered species by the U.S. Fish and Wildlife Service (Service) on April 23, 1980. The original recovery plan was approved on May 16, 1984; this is a revision of that plan. The bonytail chub is very rare. In the Colorado River Basin, few individuals have been found in the last decade, and recruitment is apparently nonexistent or extremely low. The largest known concentration of the fish is found in Lake Mohave. The decline of the bonytail chub has been attributed to stream alteration caused by construction of dams, flow depletion from irrigation and other uses, hybridization with other Gila, and the introduction of nonnative fish species.

The recovery goal in the short-term is to prevent extinction of the bonytail chub. In the long-term, once the immediate threat of extinction is removed, quantitative goals for downlisting and delisting will be addressed. Recovery criteria will be developed after completion of various recovery actions.

The major actions needed to secure the survival of the bonytail chub are:

- Prevent extinction of the bonytail chub by establishing a genetically diverse captive population for use in efforts to reintroduce the fish into the wild.
- Obtain essential information on the life history and habitat requirements of the bonytail chub.
- Resolve taxonomic problems in Colorado River basin chubs; the bonytail, humpback, and roundtail.
- Develop quantitative recovery goals and a long-term habitat protection strategy.

The bonytail chub is being recovered in concert with the humpback chub, Colorado squawfish, and the razorback sucker. The "Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin" (Recovery Program) identifies specific recovery tasks and strategies to be employed in recovering these fish in the Upper Colorado River Basin. The goal of the Recovery Program is to recover the Colorado River fishes in the Upper Colorado River Basin, excluding the San Juan River, by the year 2003 at an estimated cost of $59 million. The Service considers the Recovery Program a stepdown effort of the recovery plans for the listed Colorado River fish and the primary mechanism for implementing this plan in the Upper Colorado River Basin. Development of a similar program for the Lower Colorado River Basin is being planned. An estimated recovery cost and recovery date will be established for the Lower Basin during the development of this program.

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PART I

INTRODUCTION

History

"Bonytail" is the accepted common name for Gila elegans (Robins et al. 1980). However, "bonytail chub" was used when the species was listed in 1980 and is the name commonly used by biologists in the Colorado River basin (Valdez and Clemmer 1982). Therefore, the term "bonytail chub" is used in this plan.

The bonytail chub was listed as endangered by the U.S. Fish and Wildlife Service (Service) on April 23, 1980 (U.S. Fish and Wildlife Service 1980). Critical habitat for the species was not designated at the time of listing as it could not be specifically defined. Reproduction of this species has not been recently reported and ecological requirements are largely unknown; only incidental, large adult specimens have been positively identified in recent years. The recovery priority for the bonytail chub is ranked as 5C which indicates a high degree of threat and a low recovery potential for a species which is in conflict with some form of economic activity.

General Description

The bonytail chub was originally described by Baird and Girard (1853). The type locality was given as the Zuni River, New Mexico; however, Smith et al. (1979) suggested that the original specimens came from the Little Colorado River at the base of Grand Falls. The general description of the species has not changed significantly since 1853 although recent taxonomic clarifications have been attempted by Holden and Stalnaker (1970) and Smith et al. (1979). Bonytail chub, roundtail chub (G. robusta), and humpback chub (G. cypha) are close relatives but may have developed different morphological adaptations presumably to the flow regimes of the mainstem rivers of the historic Colorado River system.

Adult bonytail chub are gray or olivaceous on the back with silvery sides and a white belly. Breeding males have bright red-orange lateral slashes between the paired fins, a trait similar to other closely related chubs, and small tubercles on the head and anterior portions of the body. Breeding colors are more subdued and tubercles less well developed in females. A slight orange coloration is apparent at the base of the fins in both sexes throughout much of the year (Vanicek 1967). The bonytail chub generally reaches 300-350 mm (12-14 in.) in total length but larger specimens of up to 600 mm (24 in.) have been taken from Lakes Mohave and Havasu on the lower Colorado River (Minckley 1973; W. Minckley, Arizona State University, pers. comm.). The adult bonytail chub has an elongated, somewhat laterally compressed body with a long, thin caudal peduncle (frontispiece). The head is small and has a somewhat oblique mouth. The skull is concave dorsally and, in adults, the head arches smoothly into a predorsal hump. Scales are often lacking or embedded on the top of the hump, belly, or caudal peduncle (Minckley 1973). The fins are large, with dorsal fin rays 9-11 (typically 10) and anal fin rays 9-12 (usually 10)

(Holden and Stalnaker 1970). The dorsal fin origin is nearer to the tip of the snout than it is to the base of the caudal fin. Pharyngeal teeth are typical for large-river chubs at 2,5-4,2.

A combination of characters are used to differentiate adult bonytail, humpback, and roundtail chubs. Dorsal/anal fin ray counts are usually 10-10 in bonytail chub, 9-9 in roundtail chub, and 9-10 in humpback chub. The number of gill rakers on the anterior row of the second arch is usually 18 (15-21) in bonytail chub, 15 (13-17) in humpback chub, and 13 (12-15) in roundtail chub (R. Muth, Colorado State University, pers. comm.). Bonytail chub have a much narrower caudal peduncle than roundtail chub with the ratio of head length to caudal peduncle depth generally greater than five. Similar ratios for roundtail and humpback chub are less than five. The nuchal hump in adult bonytail chub rises smoothly from a concave skull while those of adult humpback chub arise more abruptly from the skull.

It was previously suggested (U.S. Fish and Wildlife Service 1984) that the humpback chub could be differentiated from the bonytail chub by the presence of an overhanging snout in the former species. However, Karp and Tyus (1989) recently ranked the degree of overhanging snout in these two fishes, from the Yampa River, using methods described by Douglas et al. (1989), and found that this character was not useful in separating them. These findings remain consistent with the original description of the humpback chub by Miller (1946), who noted the similarity in overhanging snout in humpback and bonytail chubs, but not the roundtail chub.

Although young bonytail chub may be differentiated from young roundtail and humpback chubs by certain characteristics, such as fin ray counts and the presence of larger eyes (Smith et al. 1979), positive field identification of juvenile Gila is difficult and often considered "tentative" even by knowledgeable investigators. Tyus et al. (1982a) reviewed a combination of techniques for identifying bonytail chub from the Green River, including x-rays of vertebrae, gill-raker counts, and other morphological characteristics. In the laboratory, Muth (1988) differentiated among young bonytail, humpback, and roundtail chubs based on x-rays of total vertebrae or myomere counts. However, identification of Gila species has posed a problem in the Upper Colorado River Basin (Upper Basin) because the three congeneric species may be sympatric and specimens may have morphometric characteristics that overlap (Suttkus and Clemmer 1977; Smith et al. 1979; Valdez and Clemmer 1982). Natural hybridization among the three species of Gila has been suggested by several investigators (Holden and Stalnaker 1970; Robert Miller, University of Michigan, pers. comm.; Minckley 1973; Smith et al. 1979) and artificial spawning has produced bonytail x roundtail chub and bonytail x humpback chub crosses (Hamman 1981). The significance of individuals that display overlapping morphologic characteristics in the Upper Basin remains unclear and the possibility of a polymorphic Gila complex (Holden and Stalnaker 1970; Tyus et al. 1986) is an issue that must be addressed.

The Service is currently developing plans to investigate and clarify the taxonomic status of the humpback, bonytail, and roundtail chubs in the Colorado River basin. The work will include technical experts and field researchers and is intended to determine definitively whether the humpback, bonytail, and roundtail chubs are distinct species. If they are distinct, the

key characteristics which separate them will be identified. The group of experts also will attempt to identify any recent changes in the genetic and/or morphological characteristics of the Gila complex and to relate these changes to any environmental modifications. The initial timeframe for completion of the work is an estimated 4 years.

Distribution and Abundance

Historic Distribution

The original records of bonytail chub were from the Colorado and Gila Rivers (Baird and Girard 1853; Jordan 1891; Jordan and Evermann 1896) (Figure 1). Captures in the Green River indicate bonytail chub were present in southern Wyoming in the reach where Flaming Gorge Reservoir now is located (Bosley 1960; Smith et al. 1979), in Dinosaur National Monument in Colorado and Utah (Binns et al. 1963; Vanicek and Kramer 1969; Vanicek et al. 1970), Desolation and Gray Canyons in Utah (Holden 1978), and the lower Green River in Utah (Jordan 1891; Holden and Stalnaker 1975). In the Colorado River mainstem, they were collected from near Grand Junction, Colorado, to the mouth of the Colorado River at the Gulf of California (Ellis 1914; Smith et al. 1979). Major tributaries of the Colorado River where bonytail chub were recorded included the Gila (Kirsch 1888), Salt (Evermann and Rutter 1895), and Verde Rivers in Arizona (Smith et al. 1979); the San Juan River (Cope and Yarrow 1875); and the Gunnison River (Smith et al. 1979). The species also entered the Salton Sea basin in California when that area received Colorado River inflow during 1905-07, but disappeared when salinity became intolerable (Walker et al. 1961).

The bonytail chub was reported abundant in some locations of the Colorado River drainage in the late 1800's (Jordan and Evermann 1896). Jordan (1891) seined five specimens from the Green River at Green River, Utah, and Kirsch (1888) cited an expedition on the Gila River at Ft. Thomas, Arizona, which noted that the fish "took the hook freely." A number of other reports also indicated it was common to abundant during this period (Cope and Yarrow 1875; Gilbert and Scofield 1898; Chamberlain 1904). However, some of these and later reports may be questionable due to possible use of the term "bonytail" for other Gila species, particularly the roundtail chub (G. robusta) in the Upper Basin.

There were few reports of bonytail chub for the Upper Basin in the first half of the 20th century. The species declined in the Lower Colorado River Basin (Lower Basin) during this time, disappearing from the Salt and upper Gila rivers before 1926. Miller (1961) reported that, by 1940-1942, bonytail chub were rare in the Colorado and Gila rivers near Yuma, Arizona, and absent by 1950. Soon after closure of Glen Canyon Dam in 1962, bonytail chubs were reported in Lake Powell (Kent Miller and Dale Hepworth, Utah Division of Wildlife, pers. comm.) and downstream of the dam to Lee's Ferry (Arizona State University museum records 1963-1965). "Older" fishermen reported that bonytail chub were caught in the upper Green River during the 1940's and 1950's. However, the last known riverine area where bonytail chub were common was the Green River in Dinosaur National Monument, where Vanicek (1967) and Holden and Stalnaker (1970) collected 91 specimens during 1962-1966.

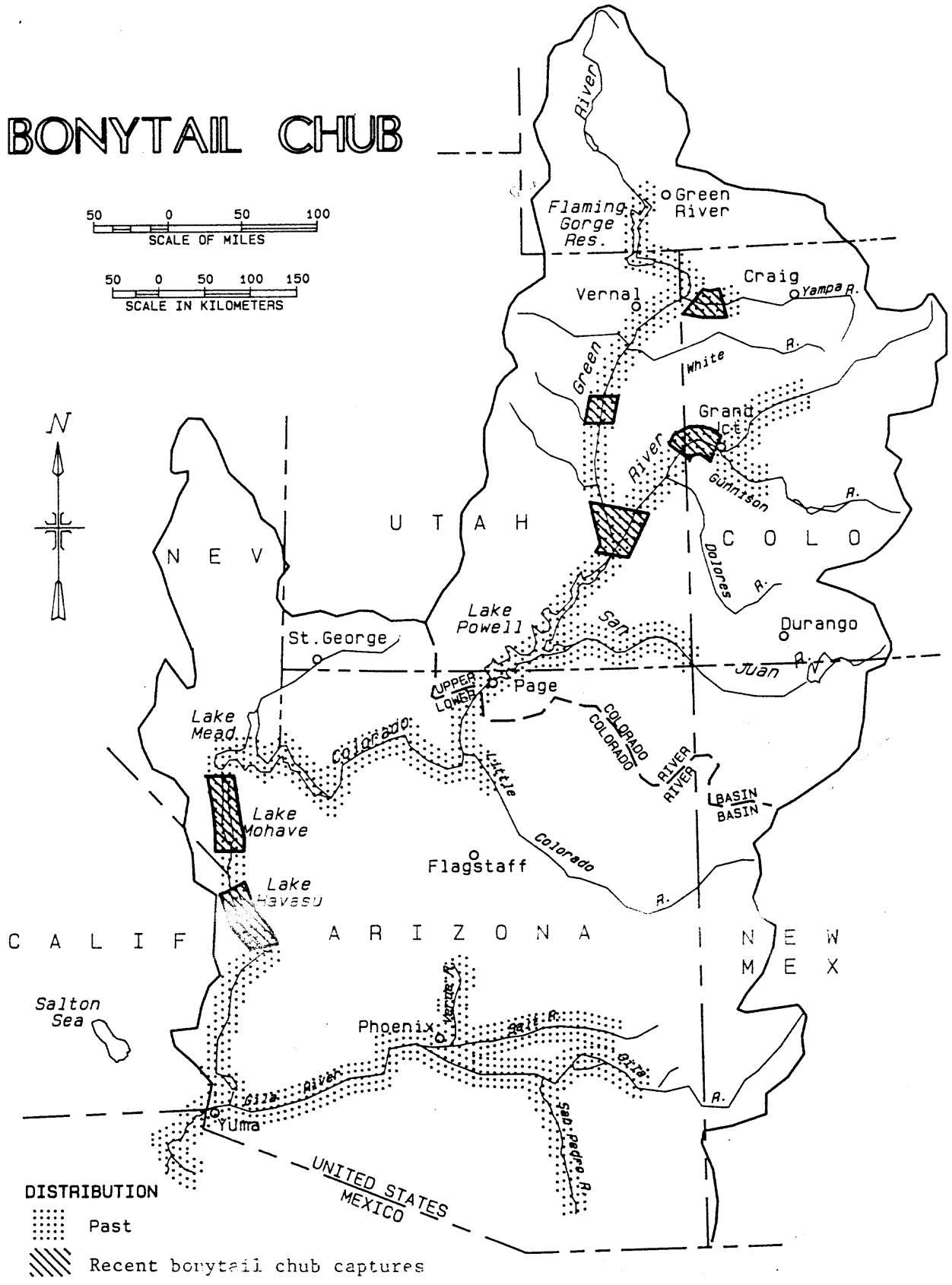

FIGURE 1: Past Distribution and Recent Captures of Bonytail Chub in the Colorado River System

Present Distribution and Abundance

The bonytail chub now is very rare. In the Lower Basin, individual fish still are taken occasionally by fishermen in Lake Havasu (W.L. Minckley, pers. comm.). A few large, old adults also are still found in Lake Mohave, but no successful reproduction has been documented there. A total of 32 adult specimens was collected by biologists from Lake Mohave from 1974 to 1987, and several more were reported by anglers. An additional 16 fish were collected from Lake Mohave in 1988 and 1989 (P. C. Marsh, pers. comm.).

Recent distribution and abundance of the bonytail chub in the Upper Basin was described by Holden and Stalnaker (1975), Tyus et al. (1982b, 1987), and Valdez and Clemmer (1982). Recruitment is apparently nonexistent or extremely low, with the most recent suspected juvenile bonytails originating only from the Desolation Canyon (Holden 1978) and Cataract Canyon areas (Valdez 1985). However, verifying recruitment is difficult due to the uncertainty that exists in the identification of juveniles.

The bonytail chub apparently was common in the Green River below the Yampa River confluence after Flaming Gorge became operational in 1962. Charles D. Vanicek, Utah State University (pers. comm.), stated he could usually catch adult bonytail chub there during 1964-1966 with the use of gill nets in eddies or with electrofishing gear, although his analysis (Vanicek 1967) did not include specimens of sizes less than 200 mm (8 in.) total length (TL) because of the difficulty in identification. However, Vanicek and Kramer (1969) reported strong year classes in 1959, 1960, and 1961 based on the capture of 62 bonytails longer than 200 mm (8 in.) TL. Holden and Stalnaker (1975) found 36 adults during a 4-year study of the Upper Basin, 29 of which were captured in 1968, 3 in 1969, and 4 in 1970. All but two of these were found in the Green and Yampa rivers within Dinosaur National Monument. No young were identified during that study. Seethaler et al. (1976) sampled the Green and Yampa rivers of Dinosaur National Monument in 1974-1976 and found no bonytail chub. Holden and Crist (1981) reported one adult 275 mm (11 in.) TL from the lower Yampa River in 1979. However, no specimens have been reported from there since (Tyus et al. 1982b, 1986). Miller et al. (1982) reported no adult bonytail chub from Dinosaur National Monument in 1981-1983, and Wick et al. (1979, 1981) caught no adults and could not distinguish among larval Gila collected there. Although roundtail chub were found in the Green and Little Snake rivers in Wyoming during a 1986 survey, no bonytail chub were captured (Johnson and Oberholtzer 1987).

In other areas of the Green River, two bonytail chub adults were caught in Desolation Canyon in 1974 (Paul Holden, BIO-WEST, and Karl Seethaler, Utah State University, pers. comm.). Holden (1978) caught one adult near Jensen, Utah, and one juvenile in Desolation Canyon in 1977. Service personnel collected several fish resembling bonytail chub from Gray Canyon in 1980 and 1981 (Tyus et al. 1982a). However, during extensive sampling conducted in 1982-1985 in the Green River and a section of the Yampa River, only one individual from Gray Canyon was tentatively identified as a bonytail chub from a total of 523 Gila specimens captured (Tyus et al. 1987).

During the period 1977 through 1983, no bonytail chub were collected from the Colorado River in Colorado or Utah or from its tributary, the Gunnison River, in surveys conducted by the Service (Valdez et al. 1982; Miller et al. 1984)

and Colorado Division of Wildlife (Wick et al. 1979, 1981). However, in 1984 a single bonytail chub was collected from the Black Rocks area of the Colorado River (Kaeding et al. 1986). Several suspected bonytail chub also have been captured in Cataract Canyon of the Colorado River within 32 kilometers (20 miles) upstream of the inflow to Lake Powell. This includes two in 1985 (one adult 386 mm [15 in.] TL and one juvenile 46 mm [2 in.] TL) (Valdez 1985), one in 1986 (383 mm [15 in.] TL) (Valdez 1987), and two in 1987 (one adult 287 mm [11 in.] TL, one juvenile 264 mm [10 in.] TL) (Valdez 1988). Ongoing studies in this canyon area may reveal additional specimens.

Studies of the lower San Juan River (VTN 1978; Bureau of Reclamation 1987 [unpublished]) did not reveal any bonytail chub. However, a bonytail chub was caught by an angler near Wawheap Marina, Lake Powell, in May 1985 (Randy Radant, Utah Division of Wildlife, pers. comm.).

Life History

This discussion is separated into three sections (riverine, reservoir, and hatchery) so that differences in observed life history requirements can be correlated with habitat.

Riverine

Bonytail chub always have been considered big- or mainstem river species. Vanicek (1967) noted that adult bonytail chub occupied pools and eddies rather than areas with more current. Spawning of bonytail chub has not been observed in a river, but extrapolation from a collection of ripe fish suggested that spawning occurred in Dinosaur National Monument during late June and early July at water temperatures of about 18°C (64°F) (Vanicek and Kramer 1969).

Vanicek and Kramer (1969) estimated growth rates of bonytail chub by back-calculation of total length based on proportional growth of scales. Young were 55 mm (2 in.) their first growing season, 100 mm (4 in.) their second season, and 158 mm (6 in.) their third season in the Green River at Dinosaur National Monument. The largest bonytail chub handled by Vanicek and Kramer (1969) was 388 mm (15 in.) and 7 years old. Scale readings are valid for the first several years of life, but annuli cannot be separated accurately in older fish. Three specimens from Lake Mohave were estimated to be between 34 to 49 years old based on otolith examination (Minckley 1985).

In the Green River at Dinosaur National Monument, Vanicek and Kramer (1969) found that young chubs, including bonytail and roundtail chubs, ate primarily chironomid larvae and mayfly nymphs. Small fish became more dependent on floating food items as they grew larger. Larger juvenile chubs ate a more diversified diet, including terrestrial and aquatic insects. During the summer, adult bonytail chub fed on terrestrial insects that probably were taken from the surface. No fish remains were found in bonytail chub stomachs. In the Gila River, Kirsch (1888) reported that food of the bonytail chub consisted "almost entirely of gasteropods and caddis-worms, which they crush with their powerful pharyngeals."

Reservoir

Life history data on bonytail chub in reservoirs have been collected by a number of biologists and summarized by Minckley (1985). Bonytail chub in Lake Mohave generally occupy lacustrine habitat rather than upstream riverine habitat near Hoover Dam. William Minckley (Arizona State University, pers. comm.), believes the cold hypolimnetic water from Lake Mead precludes use of the riverine habitat in Lake Mohave by bonytail chub. Wagner (1955) reported that the species was the most common one collected in gill nets and was usually found in areas over a clean, sandy bottom with reverse eddy current. The diet of bonytail chub in reservoirs appears to be primarily plankton and algae, although extensive food habit studies have not been carried out (Minckley 1973). Stomach analysis of specimens collected from Lake Mohave indicated they had preyed upon recently stocked rainbow trout fry less than 63.5 mm (2.5 in.) TL in size (Wagner 1955).

Spawning behavior of bonytail chub was observed in Lake Mohave (Jonez and Sumner 1954), but no young have been reported. Shortly after impoundment of Lake Mohave, approximately 500 bonytail chub congregated over a gravel bar in water up to 9 m (29.5 ft) deep. Generally, females were escorted by three to five males and fertilized eggs were apparently deposited randomly. No effort to guard the spawning areas by either sex was observed (Jonez and Sumner 1954). Based on egg development, Wagner (1955) concluded spawning began in late spring or very early summer.

Hatchery

The majority of the collecting efforts in Lake Mohave since 1974 have been carried out to obtain bonytail chub for culture purposes, producing a total of 24 fish (Minckley 1985); another 8 fish were heavily infested with the parasitic copepod Lernaea cyprinacea (Bozek et al. 1984). Six female and five male bonytail chub obtained from Lake Mohave were artificially spawned in water temperatures of 20°C (68°F) at Willow Beach National Fish Hatchery (Willow Beach), Arizona, in 1981 (Hamman 1982a). Most eggs (90 percent) hatched 99 to 174 hours later. Only 55 percent of eggs placed in 16-17°C (60°-63°F) water hatched (between 170-269 hours) and 4 percent hatched at 12-13°C (54°-55°F) (between 334 and 498 hours). Marsh (1985) incubated bonytail chub eggs at 5°C (9°F) intervals between 5°C and 30°C (41°F and 86°F). The hatching success was 35 percent at 15°C (59°F), 32 percent at 20°C (68°F), and 0.5 percent at 25°C (77°F); no eggs survived at 5°C (41°F), 10°C (50°F), or 30°C (86°F). Mean total length at hatching was 6.0-6.3 mm (.24-.25 in.). Total length of normal fry at swim-up was greatest at 20°C (68°F) (8.6 mm [.34 in.]), compared with 8.1 mm (.32 in.) at 15° and 25°C (59°-77°F). The incidence of deformed fry was highest (4 percent) at 15°C (59°F) (Marsh 1985).

Bonytail chub fry produced at Willow Beach in 1981 were reared at the Dexter hatchery (Hamman 1982b). Spawning trials on 2-year-old bonytail chub were carried out in 1983 (Hamman 1985) when 24 females were spawned over a 4-week period using carp pituitary extract to induce ovulation. The fish ranged from 45 to 227 grams (1.6-8 oz) with a mean weight of 127 grams (4.5 oz). Fecundity ranged from 1,015 to 10,384 eggs per fish with a mean of 4,677. Average number of eggs per kilogram of body weight varied from 2,302 to 13,576

(5,076 to 29,935/lb of body weight) with a mean of 7,838 (17,283/lb of body weight); egg viability averaged 67.5 percent. Eggs were hatched in Heath incubators at 21.1°C (70°F).

Bonytail chub have been placed into ponds at Arizona State University Research Park as well as earthen tanks at the Buenos Aires National Wildlife Refuge, Arizona; these stockings were made for research purposes and to produce grow-out populations for stockings elsewhere (Buddy L. Jensen, U.S. Fish and Wildlife Service and Dean Hendrickson, Arizona Department of Game and Fish, pers. comm.) (Marsh 1988). In 1983, 10,000 fry were shipped to the California Department of Fish and Game, and approximately 2,000 of these fish were placed into a small golf course pond. The young survived and grew despite an expanding population of nonnative mosquitofish (Gambusia affinis) and African cichlids (Tilapia spp.) (Linda Ulmer, California Department of Fish and Game, pers. comm.). Moreover, bonytail chub annually produce substantial year classes through natural spawning under pond conditions at Dexter (B. Jensen, pers. comm.). These data may indicate that bonytail chub can be maintained and propagated sufficiently in seminatural habitats (artificial backwaters, grow-out ponds, etc.) along the Colorado River (Minckley 1985). These populations are no longer viable or useable for captive propagation.

Augmentation stockings of bonytail chub into Lake Mohave have been conducted by the Service and the Arizona Game and Fish Department using individuals from the Dexter and Willow Beach hatcheries. In the fall of 1981, about 41,000 tetracycline-marked fingerlings from Dexter were placed into Lake Mohave (Jensen 1981); a fish captured in 1982 at 142 mm (5.6 in.) TL was probably a survivor of this stocking (T. Lyles, pers. comm.). In July 1982, 13,320 more bonytail chub were stocked into Lake Mohave from Willow Beach (L. Miller, pers. comm.). Approximately 28,000 swim-up fry from Dexter were stocked in 1983 into an isolated embayment adjacent to Lake Mohave (Dean Hendrickson, pers. comm.). Later surveys failed to recover any of these fish and the embayment was found to have been invaded by abundant numbers of nonnative fishes. In 1985, 12,618 fingerlings (102 mm [4 in.] TL) derived from natural spawning in a hatchery pond were stocked into Lake Mohave (Hamman 1985). During November 1987, 13,971 naturally spawned fingerling bonytail chub from Dexter, consisting of 12,264 individuals that averaged 76 mm (3 in.) in TL and 1,707 that averaged 165 mm (6.5 in.), were stocked. Another 20,000 fingerlings were stocked in October 1988 (B. Jensen, pers. comm.).

It is not yet known whether any of the above augmentation attempts have been successful on a long-term basis. Five of eleven bonytail chub collected from Lake Mohave in 1988 subsequently died in hatcheries and their otoliths were used by Dr. W. L. Minckley (pers. comm.) to estimate ages. Four were estimated to have been born in 1981 and thus presumably represent fish produced at Dexter and stocked in the lake. The remaining individual was estimated to be at least 10 years old. If these age estimates are correct, the latter specimen must be the product of reproduction in the wild and recruitment since the first stocking of this species in Lake Mohave was of the 1981 year class produced at Dexter.

In 1988, the Service, Bureau of Reclamation, and Utah Division of Wildlife Resources entered into a 2-year cooperative agreement to evaluate the success of introducing bonytail chub into the Green River. Objectives of the

introduction program were to monitor fish behavior and collect habitat use information for future introduction programs. A total of 35 adult bonytail chubs were implanted with radio transmitters and released during three different seasons at Island Park in Dinosaur National Monument and at Jensen, Utah. Preliminary results of the effort suggest hatchery or pond-raised adults may have difficulty adapting to riverine environments. However, the introduction program will be evaluated at the end of the first year by the respective agencies and, if necessary, modified.

Reasons for Decline

Miller (1961) indicated that decline of the bonytail chub in the Gila River system during the first half of the 20th century may have been due to habitat degradation as a result of overgrazing of grassland and riparian vegetation and poor land management practices, depletion of ground water, construction of dams, flow depletions from irrigation and mining, and introduction of nonnative species. By the early 1900's, much of the lower Gila River was dry. Droughts in the late 1800's and prolonged flooding in the early 1900's stimulated the need for flood control and storage of irrigation water on the mainstem Colorado River and its major tributaries (Fradkin 1981). Hoover (Boulder) Dam (Lake Mead) was built in 1935, Parker Dam (Lake Havasu) in 1938, and Davis Dam (Lake Mohave) in 1950, all on the Colorado River. Roosevelt Dam was constructed on the Salt River in 1913, followed by the Coolidge Dam on the Gila River in 1928, and other structures on the Salt and Verde rivers between 1925 and 1945 (Rinne 1975). Construction of these dams transformed much of the mainstem Colorado River and some of its major tributaries into either lacustrine environments, dry riverbeds, or rivers with flow and temperature regimes greatly altered from historic conditions. These changes are believed to be a major cause of decline of the bonytail chub in the Lower Basin.

Decline of the bonytail chub in the Upper Basin occurred more recently, but is similarly related to water resource development and associated habitat loss and modification. Vanicek et al. (1970) concluded that reduction in the numbers and species of native fishes in the Green River from Flaming Gorge Dam to the mouth of the Yampa River was due to the lower water temperatures and altered annual flow and temperature regimes occurring after the dam's closure in 1962. This is partially substantiated by laboratory studies by Hamman (1982b) and Marsh (1985), who demonstrated that temperatures lower than 13°C (55°F) significantly reduces hatching success. Holden and Stalnaker (1975) reported a further decrease in the numbers of adult bonytail chub in the Green River in Dinosaur National Monument after the collections by Vanicek et al. (1970) (i.e., after 1966). This decline also was attributed to the effects of the dam, particularly the decrease in summer water temperatures.

A pre-impoundment poisoning project in the Green River where Flaming Gorge Reservoir now is located is often cited as at least a partial cause for the loss of native fishes immediately downstream of the reservoir. However, a comparison of fish species present in Dinosaur National Monument before and after the program (Binns et al. 1963; Vanicek and Kramer 1969; Vanicek et al. 1970) supports the premise that the effect of the poisoning was of a short-term nature and not responsible for the almost total loss of the bonytail from that area within a decade.

Alteration of flow and temperature regimes associated with the closure of Glen Canyon Dam (Lake Powell) also is implicated as a factor in the loss of bonytail chub populations there; bonytail chub were fairly common in Lake Powell immediately after closure, but declined soon afterward (Utah State Department of Fish and Game 1964, 1969).

Introductions of nonnative fishes probably also have contributed to decline of the bonytail chub. Tyus et al. (1982b) reported that rivers of the Upper Basin have been colonized in recent times by at least 42 nonnative fish species. Kaeding et al. (1986) suggested that the synergistic effect of increases in nonnative fishes and altered flow/temperature regimes adversely impacted the bonytail chub. Valdez et al. (1982) suggested that loss of habitat for Gila species in the Upper Basin could result in severe interspecific competition.

The apparent ability of bonytail chubs to hybridize with the roundtail and humpback chubs under hatchery conditions also may be a factor in the decline of the bonytail chub (Stalnaker and Holden 1973). The very small number of bonytail chub remaining in the Colorado River basin increases the likelihood of hybridization with more abundant species of Gila.

In summary, habitat alteration caused by dams, water depletions from irrigation, interactions with nonnative fishes, and hybridization with other Gila have been suggested as the major factors in the decline of the bonytail chub in the Colorado River basin.

PART II

RECOVERY

Objective

The immediate goal of this recovery plan is to prevent extinction of the bonytail chub.

Once the immediate threat of extinction is removed and essential information regarding factors that limit survival of bonytail chub is obtained, quantitative goals for downlisting and delisting will be addressed and an estimated time-frame for recovery will be established.

The goal for recovery in the Upper Colorado River Basin, excluding the San Juan River, is 2003. A recovery date for the Lower Colorado River Basin will be established during the development of a program for the Lower Basin that is similar to the "Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin."

Stepdown Outline

1. Prevent extinction of bonytail chub in the wild.

    11. Protect in refugia.

        111. Establish and maintain refugia in at least two locations.

        112. Evaluate genetics of captive bonytail chub.

        113. Obtain wild bonytail chub.

        114. Verify taxonomic status of individuals received at refugia.

    12. Protect populations of bonytail chub and their habitats.

        121. Enforce established regulations to minimize threats.

            1211. Inform appropriate agencies of their management and enforcement obligations.

            1212. Ensure compliance with Section 7 of the Endangered Species Act by Federal agencies.

        122. Develop and implement cooperative interagency programs to protect and recover the bonytail chub.

        123. Prohibit the further introduction of nonnative fishes into the Colorado River system.

124. Protect high priority recovery areas.

13. Reintroduce hatchery-reared bonytail chub into the wild.

131. Develop and implement an artificial propagation and rearing plan.

1311. Assess and refine propagation techniques to maximize survival in wild.

1312. Maximize genetic diversity.

1313. Rear bonytail chub to a size that promotes good post-stocking survival.

132. Conduct experimental stocking of bonytail chub and identify priority recovery sites.

133. Stock bonytail chub in priority recovery sites.

2. Obtain essential information on the life history and habitat requirements of the bonytail chub.

21. Describe spawning requirements.

22. Describe role of predation/competition.

23. Describe movement patterns.

24. Identify and describe essential habitat.

25. Describe food habits and feeding behavior.

26. Evaluate aging techniques.

27. Describe age distribution and growth rates.

28. Determine reasons for and significance of hybridization.

3. Resolve taxonomic problems in Colorado River Basin Gila.

4. Promote and encourage improved communication and information dissemination.

41. Develop an information and education program to inform the public of the bonytail chub's status and uniqueness.

42. Encourage and support publication of research and other recovery results in the technical literature.

43. Develop and conduct workshops to coordinate recovery efforts.

5. Develop quantitative recovery goals and a long-term habitat protection strategy.

Narrative

Short-Term

The immediate goal of this recovery plan is to prevent extinction of the bonytail chub. The bonytail chub is extremely rare and very few individuals have been collected or identified recently, suggesting that the species may be close to extirpation in the wild. Therefore, initial efforts have been and will continue to be directed toward securing and developing a broodstock, reintroducing the wild or hatchery-produced bonytail chub within its historical range, obtaining necessary information on the species' ecological requirements, and reevaluating the taxonomic status of the Gila complex.

Long-Term

Once the immediate threat of extinction is removed and essential information regarding factors that limit survival of bonytail chub is obtained, quantitative goals for downlisting and delisting will be addressed and an estimated timeframe for recovery will be established. Recovery can best be accomplished by hatchery propagation and reintroduction, coupled with habitat protection and removal or reduction of the causes of decline of bonytail chub.

1. Prevent extinction of bonytail chub in the wild.

   The bonytail chub is presently the most endangered fish species in the Colorado River basin. Although individuals are still occasionally captured and captive stocks are being maintained, there is no evidence that any self-sustaining populations exist. Therefore, immediate action is required to prevent its extinction and maintain its gene pool. For these reasons, tasks 111-114 are considered Priority 1 recovery actions.

   11. Protect in refugia.

       Studies indicate that the few bonytail chub existing in the wild are old fish which apparently are not reproducing. In time, these fish will be lost to mortality. Therefore, genetic evaluation of captive bonytail chub should be conducted to determine if obtaining wild bonytail would be required for future reintroduction efforts. If so, wild fish should be obtained and placed in refugia for protection.

       111. Establish and maintain refugia in at least two locations.

            A refugium for bonytail chub currently exists at Dexter National Fish Hatchery, New Mexico, and should be maintained. One or more additional refugia should be established and maintained to guard against the potential loss of broodstock that could result from a catastrophic event. Possible sites for additional refugia include the Arizona Game and Fish Department's Page Springs Hatchery; fish ponds at Ouray National Wildlife Refuge, Ouray, Utah; Buenos Aires National Wildlife Refuge, Sasabe, Arizona; Palm Lake at The Nature Conservancy's Hassayampa River Preserve, Wickenberg, Arizona; and Niland Native Fish Ponds, California.

112. Evaluate genetics of captive bonytail chub.

A genetic evaluation of captive bonytail chub should be conducted. This evaluation should determine the genetics of bonytail chub broodstock, those currently at Dexter National Fish Hatchery, and those taken from the wild.

113. Obtain wild bonytail chub.

An intensive collection effort should be initiated to obtain additional wild bonytail chub from areas where they occur. A mechanism and protocol has been established for obtaining these individuals. Workers should be prepared to properly hold and transport captured bonytail chub to refugia. Proper protocol for the handling of individuals which maximizes survival should be developed and revised as necessary. Quarantine procedures at refugia must be enforced. Funds identified in the implementation schedule of this plan are considered to be sufficient to support initial collection efforts. However, if an insufficient number of wild fish are collected, additional funds may be needed for further collection efforts.

114. Verify taxonomic status of individuals received at refugia.

After stabilization, the fish received at refugia must be inspected and their taxonomic status determined by qualified personnel. A photograph of the fish on a 1 cm (0.4 in.) grid will be taken and made available to interested persons. Each fish will be tagged and a record kept of its point of origin and other pertinent information. Nonlethal techniques (e.g., electrophoresis) should be developed that can type specimens using tissues such as fin, gill filaments, etc.

12. Protect populations of bonytail chub and their habitats.

Actions must be taken to minimize threats and adverse impacts to bonytail chub and their habitats. A restriction on the stocking of warmwater nonnative fishes should be implemented since competition and predation are believed to be major threats to the survival of bonytail chub. Emphasis should be placed on developing cooperative agreements with State and Federal agencies and private groups to restrict uncontrolled stocking of nonnatives and to develop a coordinated program to protect and recover the bonytail chub.

121. Enforce established regulations to minimize threats.

Existing regulations have been established to control habitat or streamflow alteration, taking and possession of endangered fish, and other human activities that may adversely affect the species or its habitat. As studies are completed, new information may indicate that additional regulations and/or strategies are necessary.

1211. Inform appropriate agencies of their management and enforcement obligations.

All resource agencies and the public should be made aware of their responsibilities regarding the laws protecting listed species and their habitats (i.e., Endangered Species Act, Clean Water Act, Lacey Act).

1212. Ensure compliance with Section 7 of the Endangered Species Act by Federal agencies.

Section 7 consultation with the Service should be conducted to insure that Federal actions are not likely to jeopardize the continued existence of bonytail chub and that Federal agencies utilize their authorities to promote recovery of the species. Primary emphasis should be directed at protecting habitat conditions in the primary recovery sites for the bonytail chub. (See task 133).

122. Develop and implement cooperative interagency programs to protect and recover the bonytail chub.

A major cooperative effort to recover endangered fish species in the Upper Basin was initiated in August 1984. The Upper Basin Coordinating Committee consisted of representatives of the Service; Bureau of Reclamation; the States of Colorado, Utah, and Wyoming; private water development interests; and environmental groups. They had a goal of developing a plan to recover listed fish in the Upper Basin in a manner compatible with States' water rights allocation systems and interstate compacts. The "Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin" (Recovery Program) (U.S. Fish and Wildlife Service 1987) was the result. A cooperative agreement signed in January 1988 by the Governors of Colorado, Wyoming, and Utah; Secretary of the Interior Hodel; and the Administrator of the Western Area Power Administration formally implemented the program and created a 10-member Committee to oversee it. The Recovery Program applies to all drainages in the Upper Basin with the exception of the San Juan River Basin. Five basic recovery elements are identified: (1) provision for instream flows; (2) habitat development and maintenance; (3) rearing and stocking of native fish; (4) management of nonnative species and sportfishing; and (5) research, monitoring, and data management. The projected annual budget for the Recovery Program is $2,300,000 and sources of funds will include Federal and State governments, power and water users, and private donations. A $10 million fund will be requested of Congress for purchase of water rights to protect instream flows, and another $5 million will be requested for construction of facilities such as a hatchery, fish passageways, etc. Private entities proposing water projects will support the program by providing a one-time contribution of $10 per acre-feet of the average annual depletion of the project.

The Recovery Program is intended to provide for the coordinated implementation of the Service's recovery plans for the three endangered fish, including this one for the bonytail chub, in the Upper Basin. Therefore, the Recovery Program will be considered a stepdown effort of this recovery plan and the primary mechanism for implementing the recovery plan in the Upper Basin.

A similar cooperative interagency plan for recovery actions for Colorado squawfish, bonytail chub, humpback chub, and razorback sucker in the Lower Basin is currently being drafted. When completed, the Lower Basin Recovery Action Plan will be considered the Lower Basin stepdown effort of this recovery plan and will be the primary mechanism for implementing this Recovery Plan in the Lower Basin. The Service should ensure that the Upper Basin Recovery Program and the Lower Basin Recovery Action Plan currently being developed are fully coordinated.

123. Prohibit the further introduction of nonnative fishes into the Colorado River system.

A cooperative agreement should be initiated by the Service and the States of Utah, Colorado, Wyoming, New Mexico, Arizona, Nevada, and California to prohibit the augmentation or introduction of nonnative fishes that might further compete with or prey upon the bonytail chub. Stocking of nonnative species will be confined to those species, and those areas where absence of potential conflict with rare or endangered species can be conclusively demonstrated. The States, Service, and other affected Federal agencies will develop procedures and studies for reviewing and resolving disagreements with any proposed introductions of nonnative species into the Colorado River system.

124. Protect high priority recovery areas.

If studies determine that certain reaches of river provide habitat necessary for the continued existence or recovery of bonytail chub, such sensitive areas must be protected and maintained. Costs identified for this action covers only initial effects at determining habitat protection needs. Significant funds will, most likely, be needed and will be identified in the future.

13. Reintroduce hatchery-reared bonytail chub into the wild.

As additional bonytail chub caught in the wild are secured in refugia, they will contribute toward broodstock that will be used to augment the small number of bonytail chub remaining in the wild.

131. Develop and implement an artificial propagation and rearing plan.

A plan should be developed for bonytail chub propagation. The plan should identify the numbers of fish needed, rates of stocking, size of fish to be stocked, and where and when the fish would be propagated and reared. Artificial propagation and restocking is necessary to prevent extinction of the species, therefore Tasks 1311-1313 are Priority 1 actions.

1311. Assess and refine propagation techniques to maximize survival in wild.

Considerable information regarding hatchery propagation of bonytail chub has been developed through ongoing efforts in the Lower Basin by facilities such as Dexter and Willow Beach. As new information on propagation and maintenance techniques becomes available through continued efforts, such techniques will be assessed and refined as necessary to maximize survival and genetic diversity and minimize mortality. One additional year of analysis may be sufficient to finalize propagation and maintenance techniques.

1312. Maximize genetic diversity.

Maintain and propagate bonytail chub with the objective of maximizing and maintaining genetic diversity. The value of retaining the genetic integrity of both Upper Basin and Lower Basin bonytail gene pools will be recognized. It is anticipated that at least 10 years captive propagation will ultimately be required.

1313. Rear bonytail chub to a size that promotes good post-stocking survival.

Previous studies on reintroduction efforts for razorback suckers and Colorado squawfish have shown that stocking of larger fish results in greater survival. However, stocking of individuals that have become dependent upon hatchery conditions may contribute to low survival. Efforts should be made to determine and release the sizes of bonytail chub individuals that will yield maximum survival. Each release site should be monitored to assess survival of fish, as specified in Task 132.

132. Conduct experimental stocking of bonytail chub and identify priority recovery sites.

Adult bonytail chub can be used in the identification and evaluation of high priority stocking sites. Their movement, survival, and habitat selection at various times of the year may offer information on the limiting factors affecting bonytail chub survival and abundance. Additionally,

information from radiotelemetry can help determine whether interactions with other Gila species and nonnative fishes may be a problem. Adult bonytail chub should be radio-tagged, stocked, and monitored to determine their habitat requirements/limiting factors and to aid in identifying priority recovery sites. The highest priority study site for the radiotelemetry study is the Green and Yampa Rivers at Dinosaur National Monument. In addition, stocking of bonytails into some areas of the Lower Basin where the species historically occurred and habitat may still exist could provide information regarding habitat requirements and preferences.

133. Stock bonytail chub in priority recovery sites.

The highest priority recovery and/or reintroduction sites for the bonytail chub include the: (1) Green and Yampa rivers at Dinosaur National Monument; (2) Green River at Desolation/Gray Canyon; (3) Colorado River at Cataract Canyon; and (4) San Juan River, if suitable habitat appears to be present. The results of Tasks 132 and 21-27 will assist in refining or expanding this list of sites to additional areas in the Upper Basin. In addition, areas in the Lower Basin should be evaluated for their potential as recovery sites. Reintroduction programs should be prepared describing the numbers and sizes of fish to be stocked, time and location for stocking fish, years in which stocking will occur, source of fish for stocking, and a monitoring program to assess program success.

Lake Mohave, which has supported an important population of adult bonytail chub that has been used as broodstock in the recovery effort also is a high priority recovery and/or reintroduction site. Attempts should be made to augment this population through stocking. The primary purpose of the Lake Mohave population would be to serve as a wild refugium and study area for bonytail chub.

2. Obtain essential information on the life history and habitat requirements of the bonytail chub.

Recovery activities for bonytail chub can be developed only after vital information on the ecological requirements and limiting factors of the species is obtained. Studies need to be conducted on existing, reintroduced, or reestablished populations to determine the roles that predation, competition, habitat modification, and water management play in limiting the survival and reproduction of bonytail chub. Areas in both the Upper and Lower Basins may be utilized in the collection of this information, and both experimental nonessential and experimental essential populations could be established as necessary to obtain the data. Some initial information will be collected in Task 132. The extent of future work and costs will be better identified after analysis of the initial work.

21. Describe spawning requirements.

Little is known about reproduction of bonytail chub in the wild. Most of the existing information on bonytail chub spawning has been obtained through culture at Dexter. Understanding this life history process is vital in saving the bonytail chub from extirpation and eventually achieving recovery.

22. Determine role of predation/competition.

Additional information on intra- and interspecific competition and the related biological and ecological interactions must be obtained. Studies designed to answer questions of competition with or predation by nonnative species must be initiated.

23. Describe movement patterns.

Studies of reintroduced and, if found, existing bonytail chub populations should be conducted to provide information on the movement and behavior of the species.

24. Identify and describe essential habitat.

Specific physical, chemical, and biological components of the habitat required by all life stages should be described. Water velocity, depth, and substrate required for spawning, nursery, and over-wintering areas should be delineated.

25. Describe food habits and feeding behavior.

Some information has been collected, but further investigations are necessary to describe this important parameter.

26. Evaluate aging techniques.

An evaluation of present techniques used to estimate the age of bonytail must be conducted to ensure the accuracy of age estimates.

27. Describe age distribution and growth rates.

Continuous length and weight data of stocked fish should be maintained by monitoring agencies. Age and growth information should be recorded from hatchery and wild fish. This will require an evaluation of aging techniques to ensure accurate estimates of age.

28. Determine reasons for and significance of hybridization.

Hybridization may pose a threat to the continued existence of the bonytail chub genotype, especially if habitat alteration results in the disruption of normal isolating mechanisms.

3. Resolve taxonomic problems in Colorado River Basin Gila.

The taxonomic status of the bonytail chub has been questioned, largely due to the lack of definition of ontogenetic and intra- and interspecific morphological variation, plus possible hybridization among bonytail chub and other Colorado River Basin Gila. Morphological studies to date have failed to satisfactorily resolve these issues. Detailed studies on specimens collected throughout the Colorado River basin, utilizing various approaches, are needed to: (1) determine the key characteristics that separate roundtail, humpback, and bonytail chub and develop definitive criteria for identifying species and hybrids; and (2) identify recent changes, if any, in the genetic and/or morphological characteristics of the Gila complex and relate these changes to any environmental perturbations. Verification of taxanomic status is essential to determining the potential for species extinction and for guiding recovery effects, therefore this task is a Priority 1 action.

4. Promote and encourage improved communication and information dissemination.

Inter- and intra-agency communications, the sharing of information, and the education of the public about the goals, objectives, methods, and benefits of the recovery program are essential for a successful program.

41. Develop an information and education program to inform the public of the bonytail chub's status and uniqueness.

Support by the public will be necessary for a successful recovery effort. Therefore, an information and education program to inform the public must be developed by Federal and State conservation agencies. The information and education materials will be developed in formats that are appropriate for the target audiences. This may take the form of leaflets, newspaper and magazine articles, television presentations, or other similar media. The audiences will include cooperating agencies, interested organizations, and the general public. Environmental groups and the news media will be encouraged to participate in the dissemination of information.

42. Encourage and support publication of research and other recovery results in the technical literature.

All participating agencies and their contractors should encourage publication of research findings in technical literature. These agencies should provide support by funding printing or other necessary logistical support.

43. Develop and conduct workshops to coordinate recovery efforts.

Agencies should encourage communication among their professional and managerial staffs to accelerate recovery efforts. Such communication should include coordination responsibilities for implementation of the bonytail chub recovery program and conducting workshops for the exchange of information on recovery progress to keep staffs aware of state-of-the-art methods, progress, and new initiatives.

5. Develop quantitative recovery goals and a long-term habitat protection strategy.

The bonytail chub is near extinction in the wild and this recovery plan focuses on those immediate actions which are needed to prevent extinction and to gather essential life history and habitat information needed for recovery. Once the immediate threat of extinction is removed and information regarding the factors that are limiting the survival of the bonytail chub are obtained, specific long-term strategies for the protection of its habitat and the establishment of quantitative goals for eventually downlisting and delisting the species will be developed.

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PART III

IMPLEMENTATION SCHEDULE

The Implementation Schedule that follows outlines actions and costs for the recovery program. It is a guide for meeting the objectives elaborated in Part II of this plan. This schedule indicates recovery plan tasks, corresponding outline numbers, task priorities, duration of tasks, the responsible agencies, and lastly, estimated costs. These actions, when accomplished, should bring about the recovery of the bonytail chub and protect its habitat.

KEY TO IMPLEMENTATION SCHEDULE COLUMNS

Definition of Priorities

Priority 1: All actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2: All actions that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.

Priority 3: All other actions necessary to provide for full recovery (or reclassification) of the species.

Abbreviations Used in Implementation Schedule

FWE	Fish and Wildlife Enhancement
FR	Fishery Resources
LE	Law Enforcement
AZ	Arizona
CA	California
CO	Colorado
NV	Nevada
UT	Utah
BR	Bureau of Reclamation
BLM	Bureau of Land Management
NPS	National Park Service

Other Definitions

Ongoing — Task which is now being implemented, and should be continued on an annual basis.

PART III - IMPLEMENTATION SCHEDULE
BONYTAIL CHUB

Priority	Task	Task Description	Task Duration	Responsible Party FWS Region	FWS Program	Other	Cost Estimates FY-01	FY-02	FY-03	Comments
1	111	Establish and maintain refugia	ongoing	6-2	FWE,FR	CO,UT,AZ CA	25,000	20,000	20,000	Reg. 2 refugia in place at Dexter Dexter NFH
1	112	Evaluate genetics of captive bonytail chub	ongoing	6-2	FWE,FR	UT,CO,AZ, NV	5,000	2,000	2,000	
1	113	Obtain wild fish	ongoing	6-2	FWE,FR	UT,CO,AZ, NV	50,000	50,000	50,000	Attempts to get fish should be made at Lakes Mohave & Powell & upper basin rivers
1	114	Verify taxonomy	ongoing	6	FWE,FR		2,000	2,000	2,000	
1	1312	Spawn Bonytail Chub	10 years	6-2	FR	AZ,CA,CO, UT	5,000	5,000	5,000	Culture and rearing at Dexter has been successful
1	1313	Rear Bonytail Chub	10 years	6-2	FR	AZ,UT,CA, CO	10,000	10,000	20,000	
1	132	Experimental Stocking	10 years	6-2	FR	AZ,UT,CO	89,000	84,000	24,000	
1	133	Stock in Priority Areas	10 years	6-2	FR	CO UT, AZ	---	---	50,000	

PART III - IMPLEMENTATION SCHEDULE
BONYTAIL CHUB

Priority	Task	Task Description	Task Duration	Responsible Party: FWS Region	Responsible Party: FWS Program	Responsible Party: Other	Cost Estimates: FY-01	Cost Estimates: FY-02	Cost Estimates: FY-03	Comments
1	3	Resolve taxonomic problems in Gila	5 years	6-2	FWE,FR	AZ,CA,CO, CO,UT,NV	75,000	75,000	75,000	Done in coordination with humpback chub recovery actions.
2	1211	Inform agencies	ongoing	2-6	FWE	UT,CO,AZ, NV	2,000	2,000	2,000	Done in coordination with Colo. squawfish & humpback chub recovery actions
2	1212	Ensure compliance with Section 7	ogoing	6-2	FWE		40,000	40,000	40,000	Done in coordination with Colo. squawfish & humpback chub recovery actions
2	122	Implement Cooperative Interagency Programs	ongoing	6-2	FWE	UT,CO,AZ, NV	10,000	10,000	10,000	Done in coordination with Colo. squawfish & humpback chub recovery actions
2	123	Prohibit introduction of nonnative fishes	ongoing	6-2	FWE	UT,CO,AZ, NV,CA	5,000	5,000	5,000	Done in coordination with Colo. squawfish & humpback chub recovery actions
2	1311	Refine Propagation Techniques	1 year	6-2	FR	UT,CO,AZ, CA	5,000	---	---	
2	24	Identify and describe essential habitat	3 years	2-6	FWE,FR	UT,AZ,CO, CA,NV	unknown			Too early to estimate exact costs; initial info to be collected as part of Task 132
2	26	Evaluate aging techniques	2 years	2-6	FWE,FR		unknown			

PART III - IMPLEMENTATION SCHEDULE
BONYTAIL CHUB

Priority	Task	Task Description	Task Duration	Responsible Party: FWS Region	Responsible Party: FWS Program	Responsible Party: Other	Cost Estimates FY-01	Cost Estimates FY-02	Cost Estimates FY-03	Comments
2	28	Determine reasons for and significance of hybridization	3 years	2-6	FWE,FR	UT,AZ,CO, CA,NV	---	30,000	50,000	
3	124	Protect recovery areas	ongoing	6-2	FWE,FR	UT,CO,AZ, NV	2,000	2,000	2,000	
3	21	Describe spawning requirements	3 years	2-6	FWE,FR	AZ,CA,UT, CO,NV	unknown			Too early to estimate exact costs; initial info to be collected as part of Task 132
3	22	Determine role of predation	3 years	2-6	FWE,FR	UT,AZ,CO, CA,NV	unknown			Too early to estimate exact costs; initial info to be collected as part pf Task 132
3	23	Describe movement patterns	3 years	2-6	FWE,FR	UT,AZ,CO, CA,NV	unknown			Too early to estimate exact costs; initial info to be collected as part of Task 132
3	25	Describe food habitats and feeding behavior	3 years	2-6	FWE,FR	UT,AZ,CO, CA,NV	unknown			Too early to estimate exact costs
3	27	Describe age distribution and growth rates	3 years	2-6	FWE,FR	UT,AZ,CO, CA,NV	unknown			Too early to estimate exact costs
3	41	Develop public information and education program	ongoing	6-2	FWE,FR	AZ,UT,CO, CA,BR,BLM, NPS	20,000	20,000	20,000	Include as part of an I&E program for all the Colorado River Fishes.

PART III - IMPLEMENTATION SCHEDULE
BONYTAIL CHUB

Priority	Task	Task Description	Task Duration	Responsible Party: FWS Region	Responsible Party: FWS Program	Responsible Party: Other	Cost Estimates FY-01	Cost Estimates FY-02	Cost Estimates FY-03	Comments
3	42	Publish research findings	ongoing	6-2	FWE,FR	AZ,UT,CO, CA,BR,BLM, NPS	---	---	---	Done through existing meetings, workshops, and committees.
3	43	Coordinate recovery efforts through workshops	ongoing	6-2	FWE,FR	AZ,UT,CO, CA,BR,BLM, NPS	---	---	---	Done through existing meetings, workshops, and committees.
3	5	Develop quantitative goals and long-term strategy	ongoing	6-2	FWE,FR	AZ,CA,CO, UT,NV	---	---	5,000	Done in coordination with other Colorado River endangered fish.

APPENDIX I

This recovery plan was made available to the public for comment as required by the 1988 amendments to the Endangered Species Act of 1973 (Act), as amended. The public comment period was announced in the Federal Register on July 21, 1989, and closed on September 19, 1989. Over 300 press releases were sent to the print media located in the Colorado River basin.

During this 60-day public comment period five letters were received. The comments provided in these letters have been considered, and incorporated as appropriate. Comments addressing recovery task that are the responsibility of an agency other than the U.S. Fish and Wildlife Service have been sent to that agency, as required by the 1988 amendments to the Act.